

Initial evaluation of patients with renal colic: Should all patients receive non-contrast computed tomography?

Initial evaluation of patients with renal colic

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Abstract

Aim: Although spiral computed tomography (SCT) is the gold standard and the most sensitive diagnostic method for ureterolithiasis, urinary system ultrasonography (USG) is more preferred because it is cheap, widespread, non-invasive, and radiation-free. The purpose of this study was to evaluate the rate of renal colic in patients with ureteral stones and without hydronephrosis at first admission to the outpatient clinics and the data of stone related factors affecting it. **Materials and Methods:** The files of patients who admitted to the emergency and urology departments of our hospital with renal colic who had ureteral stones which were detected by SCT were evaluated retrospectively.

Results: A total of 346 patients with renal colic who admitted to our hospital were evaluated. No statistically significant relation was found between age and gender and the degree of hydronephrosis. The stone size was found to be statistically related to the degree of hydronephrosis, valid for both axial size and coronal craniocaudal lengths. There was a difference between stone localizations in terms of being hydronephrosis, and, in particular, it was found that less hydronephrosis occurs in distal ureter stones compared to other regions.

Discussion: Some of the ureteral stones may cause renal colic without hydronephrosis, and the diagnosis of ureteral stone may be missed in patients if evaluated only by urinary system USG. Therefore, the evaluation of these patients with SCT should be recommended.

Keywords

Hydronephrosis; Computed Tomography; Renal colic; Ureterolithiasis; Ultrasonography

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Introduction

Urolithiasis is a common problem worldwide, and its incidence is increasing. The lifetime prevalence of urolithiasis in the United States is 8.8% according to the National Health and Nutrition Examination Survey report [1]. Outpatient clinics and emergency department visits for stones are also increased due to the increase of urolithiasis prevalence. Particularly, renal colic due to ureteral calculi constitutes up to 1% of all emergency department admissions [2].

A sudden elevation of ureteral pressure and backflow in patients with an acute obstruction due to ureteral stone causes hydronephrosis (HN) and renal colic [3]. Patients with renal colic may have dysuria, hematuria, fever, nausea, or vomiting as well as pain. Urinary tract infection, interstitial cystitis, vaginitis, prostatitis, benign prostatic hyperplasia, glomerular disease, urothelial cancer, gastrointestinal disease, and musculoskeletal pain are among the most common diseases in the differential diagnosis of ureteral calculi in patients presenting with one of these symptoms [4]. Renal ultrasonography (USG) is one of the primary diagnostic methods in patients suspected of ureteral stones. The USG is often preferred because it is cheap, widespread, non-invasive, and radiation-free. Notably, the USG is the modality of choice to evaluate renal colic in the pediatric age group and pregnancy status [5]. Although the USG provides information indirectly by demonstrating HN in patients with ureteral stones it has some drawbacks such as the low and various sensitivity and specificity rates of 24-82% and 83-100%, respectively, in ureteral stones. Also, high body mass index, age, and stone size are the factors that may affect the diagnosis of ureteral stone with USG [6-8]. Non-contrast enhanced spiral computed tomography (SCT) is the gold standard method in the diagnosis of ureteral stones with approximately 95% and 96% sensitivity and specificity ratios, respectively. However, its use is limited due to high costs, availability, and radiation exposure [9].

Although many studies are evaluating the sensitivity and specificity of USG and SCT in patients with ureteral stones, there are not enough studies evaluating the grade of HN depending on the localization and size of ureteral stones [10-12].

This study aimed to evaluate the presence rates of HN depending on the localization and size of ureteral stones in patients presenting with renal colic.

Material and Methods

Design, search strategy, and ethical approval

The study is planned and conducted as a monocentric, retrospective cohort study. The records of a tertiary referral center database system between September 2009 and May 2019 were screened. The search diagnosis used was 'Renal colic' for the outpatient clinics of emergency and urology departments. The institutional review board of the university approved this study before data collection began (June 12, 2019, / 2019/159). As the study is retrospective, the consent to participate is not applicable.

Patient selection and eligibility criteria

The records of patients with the diagnose of renal colic who admitted to emergency and urology outpatient clinics of our hospital were evaluated. There were a total of 1175 patients'

records with the complaint of renal colic and having undergone SCT, which confirms that ureteral stone was taken into consideration. Patients with single and unilateral ureteral stone who are older than 18 years old were included in the study. Exclusion criteria were as follows: pregnancy, bilateral ureteral stones, multiple stones in the same ureter, any genitourinary pathology or anomaly that could lead to HN, prior surgery history on the same kidney within three months, patients younger than 18 years old. After the exclusions, the study included a total of 346 patients out of 1175 patients who met the criteria (Figure 1).

Data collection and extraction

All SCT's were re-evaluated by one urology specialist (DR.A.F.B.) after the radiologist. The sizes of stones were calculated on both axial and coronal SCT sections. All stone sizes were noted as axial diameter (AD) and coronal craniocaudal length (CCL) in millimeters (mm). HN was classified as no, mild, moderate, and severe. Stone localizations were classified and noted as a ureteropelvic junction (UPJ), proximal ureter, middle ureter, distal ureter, and ureterovesical junction (UVJ).

Statistical analysis

All statistical analyses were performed using IBM SPSS for Windows Version 22.0. Continuous variables were presented as mean \pm standard deviation (SD) or median [min-max] values and tested by the Student's t-test or the Mann-Whitney U test. Categorical variables were presented as numbers and percentages. The differences between the groups in terms of categorical variables were examined by the Chi-square test. The normality of continuous variables was analyzed by the Kolmogorov-Smirnov test. Since variables were not normally distributed, the Mann-Whitney U and the Kruskal-Wallis tests were used to identify differences between groups in terms of continuous variables. P-values of <0.05 were considered statistically significant.

Results

The mean age of the patients was 49.1years (SD 15.3). Two hundred and thirty (66.4%) patients were male, and 116 (33.6%) were female. Of the 346 patients, 49(14.2%) did not demonstrate any HN. Also, the total ratio of patients without HN and with mild HN was 53.7% (186). Only 11% of the patients had severe HN (Table 1). The localization distributions of ureteral stones were as follows: UPJ 11.2%(39), proximal ureter 27.4%(95), middle ureter 20.5%(71), distal ureter 24.5% (85), and UVJ 16.1%(56).

Age and gender were not associated with the degree of HN. The only parameter which was significantly associated with the degree of HN was the stone size. HN has significantly associated both with AD and CCL ($p < 0.001$ for both).

Statistically significant less HN was accompanying to only distal ureter stones when all the localizations of ureteral stones taken into consideration. There was statistically significant less HN at the distal and UVJ stones when the mild HN and non-HN group taken into consideration as a group ($p = .000$). Stone sizes decreased proximal to distal ureter both in AD and CCL, which is an expected data. Therefore, distal ureteral stones cause less HN (Table 2).

Both AD and coronal CCL were found to be higher in patients with HN. The mean AD was 5.635mm in patients with HN and

5.031mm in patients without HN, and the difference was statistically significant (p=0.045) The mean CCL was 8.012 mm in HN patients and 6.654 mm in no HN patients, and the difference was significant (p=0.033). The mean AD was calculated as 5,014 mm and 6,169mm when the groups were divided into two groups as no HN + mild HN and moderate HN + severe HN, and the difference was even more significant. When the same evaluation was made for CCL the values were found to be 6,786 mm and 9,019 mm no HN + mild HN and moderate HN + severe HN, respectively. This difference was also statistically significant (Table 3).

Table 1. Distributions of the severity of hydronephrosis according to the genders

		The severity of Hydronephrosis				Total	
		No	Mild	Moderate	Severe		
Gender	M	n	36	99	75	20	230
		%	15,7%	43,0%	32,6%	8,7%	100,0%
	F	n	13	38	47	18	116
		%	11,2%	32,8%	40,5%	15,5%	100,0%
Total		n	49	137	122	38	346
		%	14,2%	39,6%	35,3%	11,0%	100,0%

Table 2. The absence and presence of hydronephrosis due to the stone localizations

			HYDRONEPHROSIS		Total
			NO	YES	
Stone localization	UPJ*	number	4	35	39
		%	10,3%	89,7%	100,0%
	Proximal ureter	number	6	89	95
		%	6,3%	93,7%	100,0%
	Middle ureter	number	5	66	71
		%	7,0%	93,0%	100,0%
	Distal ureter	number	25	60	85
		%	29,4%	70,6%	100,0%
	UVJ**	number	9	47	56
		%	16,1%	83,9%	100,0%
Total		number	49	297	346
		%	14,2%	85,8%	100,0%

*UPJ: Uretero pelvic junction, ** UVJ: Uretero vesical junction

Discussion

The diagnosis and treatment of patients with ureteral stones may be delayed due to possible false-negative results when the evaluation is made only with USG. It is stated in the literature that the sensitivity of ureteral stone diagnosis with USG is very low, particularly in the middle and distal ureter parts, and the main reason for this is suboptimal examination caused by gas in the intestine [6].

Although sensitivity and specificity studies have been performed for USG and SCT, the real HN ratio due to the urinary stones with renal colic is not known precisely. The rate of HN due to ureteral stones varies between 69% to 83% in the literature [10,13]. In a recent study by Song et al., this rate was reported as 89% [3]. In other words, at least 10% of patients with the ureteral stone diagnosis can be omitted if evaluated only by USG. In our study, 14.2% of the patients with renal colic and ureteral stones did not have any HN, and 43.5% had mild HN. USG is a radiological imaging method that is dependent on the person performing, and if the patients with mild HN are ignored, the proportion of misdiagnosed ureteral stone patients by USG will increase. This rate was found 70% in Song et al.'s study [3], and %53.7 in our study.

It should not be disregarded that the frequency of HN detection in such patients increases with the development of tomography devices and techniques in the last two decades, including our study. In our study, mild HN was present in 43.5% of patients. Previously, this patient group could not be diagnosed by tomography. Ionizing radiation exposure is another popular issue which was decreased with new stone protocol tomographies like SCT. However, tomography has been associated with an increased risk of suspected long-term cancer due to ionizing radiation exposure [14].

In our study, the factors affecting the presence and degree of HN in patients with ureteral stones were evaluated in detail. Similar to other studies, no significant relationship was found between age and sex and the presence and degree of HN. However, in addition to other studies, it has been found in our study that the stones in the distal parts of the ureter and the UVJ lead to less dilatation. Song et al. found no correlation between stone localization and HN [3].

In our study, as in many studies, HN was found to be directly related to stone sizes. In Song et al.'s studies, both AD and CCL were significantly related to HN. In contrast to Ueno et al.'s studies [15], which indicated that CCL was not necessary, CCL was significantly increasing the presence and grade of HN such as AD in our study.

Table 3. The mean sizes of stones due to the absence, presence, no+mild, and moderate+severe groups of hydronephrosis

		Hydronephrosis					Total
		No	Yes	P value	No + Mild	Moderate + Severe	
Axial Diameter	Mean(±SD*) (mm**)	5,031 (±2,38)	5,635 (±2,43)	.045	5,014 (±2,34)	6,169 (±2,39)	5,551 (±2,43)
	N (%)	49	297		186	160	346
Coronal Craniocaudal Length	Mean(±SD*) (mm**)	6,654 (±3,47)	8,012 (±4,30)	.033	6,786 (±3,74)	9,019 (±4,42)	7,821 (±4,21)
	N (%)	49	297		186	160	346

*SD: Standard deviation, **mm: Milimeters

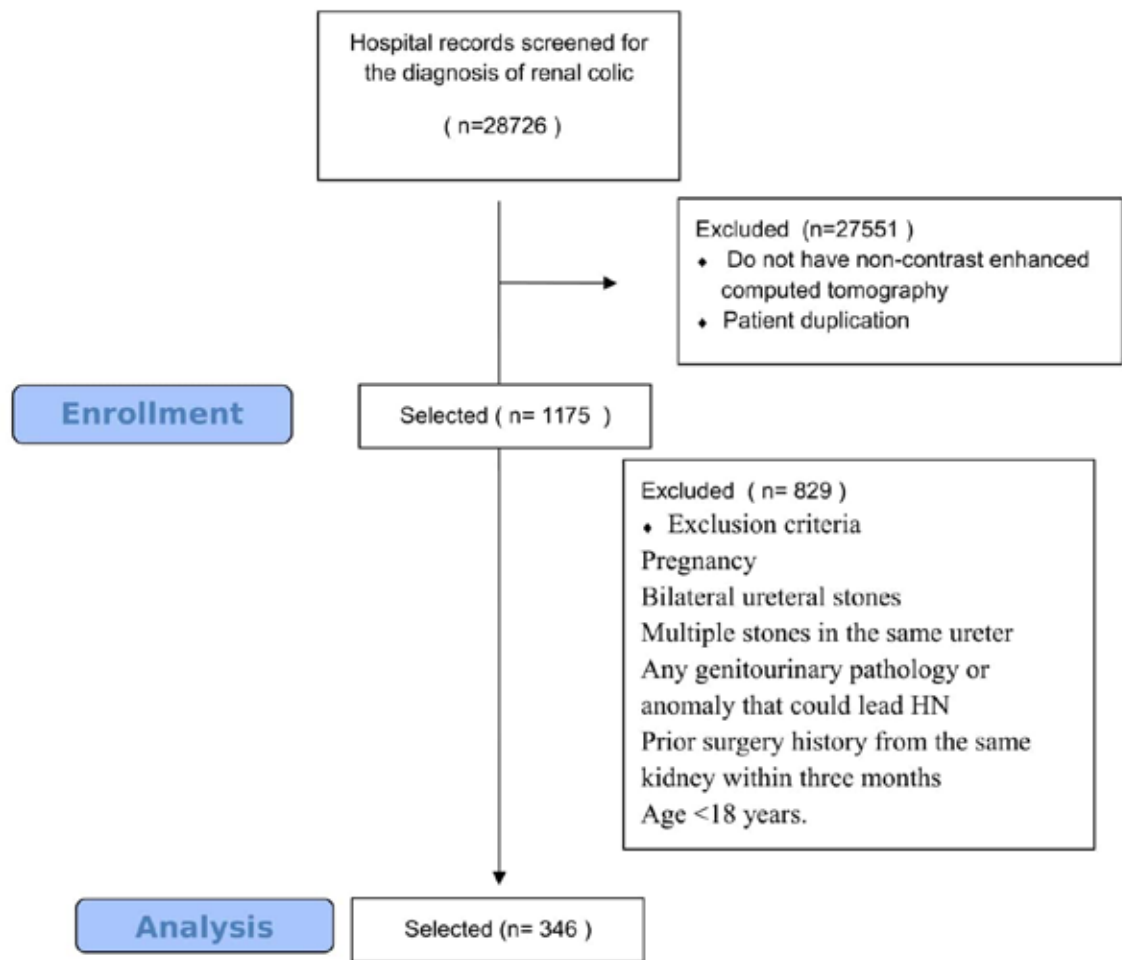


Figure 1. Flow chart of the inclusion of the patients

The retrospective design of our study is one of the limitations. Additionally, some selection bias may exist in our study due to the selection of the patients with a diagnosis of renal colic. The patients with less painful ureteral stones could have been recorded to the database system as flank pain and not renal colic. So, these patients could not have been included in the study, and this may have caused some selection bias. Furthermore, as our hospital is a tertiary referral center, patients with more pain could have been directed to our hospital, which also may lead to selection bias. Another limitation is the existence of a patient group of renal colic without the evaluation of SCT. There could be some ureteral stone diagnose-omitted patients in this group. A prospective study would have been excellent to achieve the most accurate results. However, the fact that tomography leads to ionizing radiation exposure limits and prevents the implementation of such prospective studies. The serum creatinine levels were not included in this study. This may be a limitation. However, the normal creatinine limits of each patient can vary due to multiple factors, and the deviation from normal could not be evaluated. Also, limited studies exist in the literature to evaluate the creatinine levels. In the study, by Song et al., they concluded that despite the small differences between HN groups in terms of creatinine levels, the significance appears to be minimal, which were not statistically meaningful [3].

Conclusion

The most important conclusion to be drawn from this study and literature review is that at least 10% of patients presenting with renal colic may not have HN and the correct diagnosis can not be reached only with renal USG. Therefore, the diagnosis of ureteral stones may be missed, which may lead to permanent kidney damages. Although it is decided by examining the patient's clinic, it is appropriate to emphasize the necessity of diagnostic SCT in ongoing and recurrent renal colic cases since SCT is the gold standard technique to detect ureteral stones. However, prospective larger studies are needed to learn real ratios of ureteral stones not causing HN.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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